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Credit Constraints on Farm Household Welfare in Rural China: Evidence from Fujian Province

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Abstract: This study investigates the effect of demographic factors on formal and informal borrowing households in rural Fujian Province. The study tests whether credit constraint affects rural farmers' welfare in the studied region, using a probit regression and endogenous switching regression model to analyse data collected in 2017 from 960 farm households. Analysis shows that age, poverty, household size, and farmland size operate to constrain credit in formal borrowing. Results also indicate that level of education, farm land size and age have significant impacts on rural household borrowing from informal sources. The results from the endogenous switching model approach suggest that credit constraint does have a significant impact on rural farmers' consumption and welfare in Fujian province.

Keywords: China; rural households; credit constraint; informal borrowing; welfare

1. Introduction

As is likely to be the case anywhere, where there is poverty, credit is a necessary and important factor in agricultural production systems. Wang et al.'s [1] survey on 2037 counties in 30 provinces of China in 2010 found that rural residents generally face credit constraints. Credit access can significantly increase the ability of households to meet their financial needs for agricultural inputs and productive investments. This is especially so, for households with little to no savings [2]. With limited credit, rural farmers cannot purchase inputs as needed and consequently must limit their production and consumption choices [3]. The inability to acquire formal credit has often been argued to be a crucial constraint in expanding farmers' production and largely restrains farmers from improving their living conditions and welfare [4,5]. Feder et al. [6] argued that in China, one additional yuan of credit can yield 0.235 yuan additional gross value of output in rural areas. This result is consistent with Guirkinger and Boucher's [7] study which showed that a 27 percent loss of agricultural output was associated with credit constraints in rural Peru.

In addition to maintaining consumption of basic necessities, access to credit can increase poor farmers' risk-coping ability and help them alter their risk-coping strategies so that farmers may be willing to adopt new and riskier strategies with higher potential return in their production instead of risk-reducing but inefficient strategies [5,8]. Further, Hermes and Lensink [9] maintain that access to credit may contribute to a long-lasting increase in income by means of a rise in investments in income generating activities and to a possible diversification of sources of income for low income groups,

particularly rural households. Therefore, credit is a powerful instrument to help poor people invest and break out of a 'vicious cycle' of poverty because it has the potential to improve the users' incomes and savings, and consequently, enhance investment and reinforce high incomes [10].

In China, rapid industrialisation and urbanisation have brought great change to the structure of rural communities and the development of more efficient agricultural production. Liu [11] studied labor force participation in the agricultural sector from 1978 to 2005, finding a decrease from 90.8 percent to 47.9 percent. This dramatic change is likely to have a substantial impact on the economy. Liu's analysis predicted a decrease in the proportion of the production value of coastal agricultural contributions to GDP and that the rural agricultural labor force will continue to decrease to 6 percent and 32.2 percent, respectively by 2020. Furthermore, China's farmland resources continue to decrease with the expansion of urbanisation and conversion of agricultural land to industrial use. For the period of 2000 to 2008, China's farmland has decreased by 11.48 million ha [8]. In China, the issue of abandonment of farmland and its conversion to other uses is a reflection of the changes in requirements for rural production. With these changes in land use and increased population pressure nationwide, further development of rural land for agricultural production will depend upon strengthening the rural credit marketplace and increasing the efficiency of credit capital use [12].

However, previous studies have found that rural households in China suffered credit constraint from formal credit sources [2,3,13,14]. Chinese formal financial institutions have strict requirements for granting loans in areas and lending is limited due to high financial risk. Rural households are vulnerable to covariate shocks (covariate shocks include extreme weather, disease epidemics, etc.), have relatively few assets for collateral (land is owned by the state, and farmers cannot use land as loan collateral), and have low returns (interest ceilings are set by the government) from rural loans [2,13,15]. As a consequence, most rural households in China rely on the informal credit market to meet their credit needs. Dong et al. [15] reported that in 2007, only 33 percent of rural households could get access to formal credit in Xinglonggang County, Heilongjiang Province, and more than 40 percent of farmers had financial demands but could not get sufficient financial support from formal credit channels.

In addition, poor rural households are more likely to be credit constrained from both formal and inform credit sources [14,16]. Poor rural households lack collateral, which results in credit constraints from formal credit sources that restricts their participation in additional income generating activities. It further impoverishes them by depriving their households of an opportunity to invest in social capital to expand their social network. This acts as a further constraint by isolating them from informal credit sources [17]. The social network is the most important key determinant for farmers' access to informal credit, as informal borrowing is a resource traded among friends and relatives or via their social networks [14,18]. Therefore, credit constraint is one of the more substantial factors that reinforces the poverty trap among the rural poor [17].

To relax credit constraints in the rural credit market, an appropriate strategy is to direct both informal and formal credit sectors to work better towards the rural development goal since both sectors coexist and interact. A better connection between the two credit sectors would enable one sector to overcome its weaknesses by gaining from the others' strengths [19]. This will enable the informal sector to serve the rural community efficiently instead of attempting to diminish its operation and existence.

In 2005, the China Banking Regulatory Commission (CBRC) relaxed the conditions of entry into the rural credit market for township/village banks, private loan companies and rural mutual cooperatives. This policy change was undertaken with the aim of reducing capital shortages in rural areas [15]. These credit schemes were designed to enhance market access, diversify rural financial institutions to extend credit facilities and to increase rural household incomes and levels of consumption [17]. However, financial supports of all sorts in rural areas are still marginal compared to the urban areas. Wang [20] showed that urban dwellers can get financial support 13 times more than those in rural areas. The average ratio of per capita loans is 13.17:1 between urban and rural areas in China [12]. From 2000 to 2008, the absolute size of the difference in per capita urban and rural loans rose from 4121.39 RMB to 8106.72 RMB [12].

In 2005, government administrators initiated a set of policies focused on promoting agricultural and rural development to spur the rural economy and confront the striking inequality between urban and rural regions [17]. The resulting national “New Rural Campaign” was initiated in 2006, which included an emphasis on deliberate financial intervention in the rural economy [17,21]. This liberalisation of the credit market is likely to have long term effects, reshaping the rural financial system in China and enhancing the process of rural development [17]. It is thus important to identify the factors determining credit constraints in rural China and examine the impact of these on farm household welfare.

This study aims to identify the possible effects of household demographic factors on credit access to both formal and informal credit sources. Analysis will utilise survey data collected from Fujian province in 2017. Beyond assessing the influence of demographic factors on gaining credit, we will also examine the impact of credit constraints on farm households’ welfare. Results from our empirical analysis may provide insight useful in the formulation of rural credit policies and for efforts aimed at enhancing rural production in China.

The remainder of the paper is organised as follows. Section 2 reviews the literature on credit constraint (both formal and informal borrowings) and households’ welfare. Section 3 presents the research data and descriptive statistics. Section 4 describes the research methodology. Section 5 reports empirical results and Section 6 concludes the study.

2. Literature Review

2.1. Credit Constraint from Formal Borrowings

Credit constraint is the status when households’ demands for credit are not met. This happens when their loan demands are partially or completely rejected by the credit provider [22], or if they have been discouraged to lend due to their perception of no chance of gaining credit [23,24]. Given the negative impact of credit constraint, great efforts have been spent on identifying factors affecting households’ credit constraint, particularly in rural area.

Grant [25] estimated the credit constraint among US households and found that credit constrained households are usually single, white, female college graduates who have just started their first well-paid job. They conclude that credit constraint is affected by the marital status, race, gender, education and income of the household head. Similarly, Kofarmata et al. [26] show that the rural credit constraint in Nigeria is negatively affected by the education level of farmers and family members, while it is positively impacted by the high non-agricultural income and secondary occupation. Using Pakistan Rural Household Survey 2001 and 2007 survey data from 160 farm households in Punjab, Akram and Hussain [27] add that collateral is one of the major constraints for formal lending of rural households in Pakistan. About 77 percent of borrowers use lands as collateral. Thus, those without lands such as tenants and share croppers were excluded from the credit programmes. Jia et al.’s [17] study on rural households in North China Plain in 2005, Chaudhuri and Cheral’s [28] study on rural households in India and Tran et al.’s [29] study on rural farmers in Vietnam’s North Central Coast region also found negative effects of farm land size on the probability of the rural household’s credit constraint. This is explained by the fact that these rural lands are not acceptable as collateral for the loan and thus, are not helpful for the farmer’s repayment capability [17]. Besides, large households and the poor are often constrained from formal lending [17,28].

2.2. Informal Borrowings

The Chinese rural financial capital market reflects the traditional paradigm found in many developing countries. Generally, formal credit institutions are highly centralised and heavily dependent on the government budgets. Private lending is usually highly regulated and often considered illegal [30]. In these situations, formal financial institutions tend to lack enthusiasm for participating in the rural loan marketplace. Therefore, loans from informal financial sources have become the main channels of

financing in rural China. It has been documented that 61.68 percent of rural loans were obtained from informal credit sources in 2009, while only 37.09 percent of cumulative rural loans borrowed were from banks and credit cooperatives in the same period [30].

Guo and Jia [31] defined informal finance exclusively in terms of the lender-borrower relationships that exists between friends and relatives. Such relationships are powerful components in borrowing and lending situations. Studies have confirmed that borrowing from friends and relatives dominates the informal rural credit market in China [32]. Turvey and colleagues [32] found that nearly two out of three rural loans are from friends and relatives. Li and Zhu's [33] study provided a similar result, documenting that 67.8 percent of Chinese rural households' loans were from relatives and friends.

Studies investigating the preference for informal borrowing go beyond a focus on the topic of credit constraint from formal credit sources [17]. Using a 2005 survey of 337 rural households, Jia et al. [17] found weak substitutability between formal and informal lending. The informal market is characterised by the important role of initial assets over the problem of information asymmetries. Therefore, many authors analyse the credit constraint without distinguishing formal and informal markets. For example, Zeller [22] analyses the credit rationing of both formal and informal lenders in Madagascar. They found that these two lenders rely on locally available information to assess the borrower's creditworthiness. The household wealth, debt-servicing obligations, and income are main criteria affecting the household's credit rationing. Similarly, Barslund and Tarp [34] assess the credit constraint from both formal and informal lending of 932 rural households in four Vietnamese provinces. They found that education and credit history negatively affect the credit rationing of farmers. In addition, there are significant differences in the credit constraint amongst the four provinces. Tang et al.'s [2] study on farmers in Heilongjiang Province, China surprisingly reveals that farmers who need the credit the most have higher probability of being credit constrained. These households are represented with more farming land and off-farm income. The authors suggest that the Chinese credit markets are operating below their potential. However, Lin, Wang, Gan, Cohen, and Nguyen [35] examined the formal and informal borrowings separately on Chinese rural households and revealed that informal borrowing is affected by the annual household nonagricultural income, children presence, social networks and communication expenses.

2.3. Credit Constraint and Households' Welfare

Credit constraint is a major factor contributing to the productivity reduction and slow economic development in rural areas [36]. Access to rural credit largely affects farmers' investment and consumption decisions [2,37]. This is because credit access enables the rural households' ability to satisfy their financial needs, which allow them to spend on agricultural inputs and productive investments. Rural households which are constrained from the credit are limited to the participation in many income generating activities. While credit constraint is not necessarily a cause of poverty, it obviously exaggerates it [17,38].

Credit constraint has been empirically found to have negative influence on rural household welfare. Baiyegunhi and colleagues [39] conducted research on households in the Eastern Cape province in South Africa. They indicate that non-constrained households have higher monthly expenditure than constrained counterparts. Similarly, Tran et al. [29] found a lower consumption expenditure among credit constrained households compared to randomly selected households. Similar findings are also found in Briggeman et al.'s [40] research on US farm and nonfarm households, and in Li and Zhu's [33] study on Chinese rural households. Li and Zhu [33] add that the welfare losses are larger if the household's credit demand is fully rejected."

3. Data and Descriptive Statistics

3.1. Sampling Method and Data Collection

Data were collected through a rural household survey relying on face-to-face interviews. These were conducted between May 2017 and September 2017 in Fujian province, China. Fujian is one of the largest agricultural provinces in China, where rural households are geographically dispersed in coastal, plain and mountain areas. A wide variety of agricultural crops are in production, along with aqua-culture and livestock production. The survey was administered in 43 national level and provincial level rural production observation posts (counties/villages) (The observation posts were established in China since 1985, and aim to help the central government in efficiently gathering the updated rural households' production and development data. Up to year 2016, there are a total of 360 national level observation posts (counties/villages) and 200 provincial level observation posts. The provincial observation posts are supplementary for the national level observation posts. Over 2000 full time employees are employed by these national level and provincial level observation posts [41]. There are a total of 43 long term and fixed rural production observation posts (counties/ villages) in Fujian province. The 11 fixed national rural observation posts are at the national level and 32 rural production observation posts are at the provincial level.). These observation posts are spread in nine major cities in Fujian province. These counties/villages account for more than 80 percent of the rural (agricultural) production output in Fujian province (see Table 1).

Table 1. Outputs of agricultural related industry in Fujian province in 2016.

Sample Cities	GDP of Agricultural Related Industry (in billion RMB)	Total Population (10,000)	Non rural Population (10,000)	Rural Population (10,000)	Percentage of Rural Population (%)
Zhangzhou	37.087	500	143.86	356.14	71
Sanming	25.208	253	102.05	150.95	60
Quanzhou	17.846	851	350.77	500.23	59
Nanping	28.923	264	109.98	154.02	58
Ningde	25.309	287	120.53	166.47	58
Putan	11.512	287	131.18	155.82	54
Longyan	20.062	252.08	121.9	130.18	52
Fuzhou	43.469	750	380.85	369.15	49
Xiamen	2.393	386	343.11	42.89	11

Note: City is ranked by the rural population percentage. Source: Wind data base.

The sample households were randomly chosen from listings provided by village cadres in the 43 national and provincial observation posts, with each subsample proportionately representative of the county/village population. A total of 991 rural households were asked to participate. A total of 963 surveys were returned, and 960 surveys were complete and useable, yielding a response rate of 96.87 percent.

Table 1 shows that our study regions (the cities are, Zhangzhou, Sanming, Quanzhou, Nanping, Ningde, Putan and Longyan.) are heavily engaged in agricultural production, with more than half of the population living in rural locations. In Fujian province, there are 253,000 households categorised as poor, based on China's official national poverty line, as published by the Fujian People's Congress (FPC) [42]. We use the figure provided by the FPC for our definition of poor households, those that have annual disposable incomes of less than or equal to 2,855 RMB per person. Our survey result documents 46 (4.79 percent) rural households (out of 960) as certified poor.

Credit constraint was measured via the direct elicitation technique described by Boucher and colleagues [43] and often utilised for studying the phenomenon (see [17,29,32]). This method uses survey questions to separate the households with credit constraint from those without credit constraints. In our study, credit constraint occurs when the household has unmet credit excessive demand relative to supply. This is referred to as quantity rationing, which reflects the lender's unwillingness to offer

credit. Quantity rationing is a type of non-price rationing, which arises from information asymmetry and enforcement problems associated with loan contracts [44]. Two other types of non-price rationing are transaction costs rationing and risk rationing. They discourage rural households from attempting to gain formal credit due to related transaction costs, such as time and effort involved in the contracts and the excessive concerns about their repayment capabilities [44]. We do not consider transaction costs rationing and risk rationing as credit constraint in our study because the results are not different from quantity rationing results. It suggests that quantity rationing is more important in our study.

Using the quantity rationing definition, we first identify the household's demand for credit by asking the households whether they need to borrow money from any credit source. A response of "no" implies that they are not credit constrained. For those who answered "yes", this means they have loan demand. Next, we ask whether they apply for a loan. For those who answered "yes", we asked two additional questions. The first question considers if their applications were rejected by formal credit institutions. The second question asks if they have borrowed insufficient funds, which means that the loan amount received from formal financial institutions is less than what the household has requested. The households answering "yes" to either of these two questions can be categorised as credit constrained due to quantity rationing. A "no" answer to these two questions suggests that the household is not credit constrained.

Based on the survey responses, there are 269 households (28 percent of total surveyed households) that sought credit from formal sources, in which 42 households were rejected by formal institutions (see Table 2). The main reason for rejection is lack of collateral. Among the 227 households which successfully obtained the loan, the survey result shows that 154 households did not receive sufficient amount of funds. Based on the information provided by the households, 196 households are categorised to be credit constraint accounting for 20.4 percent of total surveyed households.

Table 2. Reasons for households' formal credit constraint condition.

Respondent Status	Need to Borrow from Any Credit Courses		Don't Need to Borrow from Any Credit Courses		Total	
	Count	%	Count	%	Count	%
Number of respondent households	454	47.29	506	52.71	960	100
Credit Application Status	Households Who Applied for Formal Credit		Household Who Did Not Apply for Formal Credit		Total	
	Count	%	Count	%	Count	%
Number of respondent households	269	28	691	72	960	100
Number of credit constrained households	196	20.4				
Constrained Borrowers and Reason						
Rejected borrowers	42	4.4				
+ Lack of collateral	22	2.3				
+ Other reasons	20	2.1				
Insufficient fund	154	16.1				

Table 3 shows households' informal borrowing reasons. The survey results confirm that the rural households rely heavily on informal credit sources, with 280 households borrowing from informal credit sources, which is more than the number of households that borrowed from formal credit sources (227 households). The major reasons for household informal borrowing are no collateral (13.5%), flexible in term of payment schedule (14.5%) and fast loan processing (16.3%).

Table 3. Households informal borrowing condition and reasons.

Credit Application Status	Households Who Applied for Informal Credit		Households Who Did Not Apply for Informal Credit		Total	
	Count	%	Count	%	Count	%
Number of respondent households	280	29.2	680	70.8	960	100
Informal Credit Borrowers and Reasons ^a	Count	%				
No collateral requirement	130	13.5				
Flexible in term of payment schedule	139	14.5				
Low interest rate	52	5.4				
Fast loan processing	156	16.3				
Other reasons	31	3.2				

^a The total number of respondents is larger than 280 because the respondents can choose more than 1 option.

3.2. Households' Summary Statistics

Table 4 presents the descriptive profile of credit constrained and unconstrained households. Only 20.41 percent of total female households are credit constrained, compared to 79.59 percent of male households. It also documents that the percentage of credit constrained households decrease with an increase in age. Education also has an impact. The proportion of credit constrained households where the member holds a high school degree or more advanced degree (51.02 percent) is slightly higher than households where primary or lower education (48.98 percent) is characteristic. The results of χ^2 testing indicates that gender is significantly related to credit constraints at the five percent level. Age and education level are also significantly related to credit constraints at the one percent level.

Table 4 also reveals that seven out of 46 poor households (15.22 percent) are constrained by formal credit institutions. The proportion of credit constrained households whose income is from agricultural and related production is lower than household income in non-agricultural activities. There are significant differences between credit constrained and unconstrained household groups in terms of total annual income, consumption and expenditure per capita.

A majority of the households in our sample belong to the 35 to 55 years age group and have a primary school education or hold a lower qualification. Most of the respondents' households comprise five members. Nearly all of the respondents were engaged in farming activities, but only 27.19 percent of their earnings were agriculturally related. The average household's farmland was 0.32 ha, with an annual income of 164,618.6 RMB, and only 4.79 percent of the respondents were certified as poor.

Table 4. Profile of credit borrowed survey respondents.

Characteristics	Credit Constrained Household		Credit Unconstrained Household		All Respondents		Statistical Test
	Count	%	Count	%	Count	%	
Gender							
Male	156	79.59	540	70.68	696	72.50	$\chi^2 = 5.2657^{**}$
Female	40	20.41	224	29.32	264	27.50	
Age group							
Below 35	55	28.06	133	17.41	188	19.58	$\chi^2 = 23.9107^{***}$
35–55	120	61.22	435	56.94	555	57.81	
Above 55	21	10.71	196	25.65	217	22.61	
Education level							
Primary school or lower	96	48.98	549	71.86	645	67.19	$\chi^2 = 8.3843^{***}$
High school and above	100	51.02	215	28.14	315	32.81	

Table 4. Cont.

Characteristics	Credit Constrained Household		Credit Unconstrained Household		All Respondents		Statistical Test
	Count	%	Count	%	Count	%	
Poor							
Certified as the poor	7	3.57	39	5.10	46	4.79	$\chi^2 = 2.5208$
Non poor	189	96.43	725	94.90	914	95.21	
Occupation type							
Farm	66	33.67	254	33.25	320	33.33	$\chi^2 = 3.6057^*$
Non-farm	130	66.33	509	66.62	639	66.56	
Missing value	0	0	1	0.13	1	0.11	
Main source of income							
Agricultural related	68	34.69	193	25.36	261	27.19	$\chi^2 = 4.4154^{**}$
Non-agricultural related	128	65.31	568	74.64	696	72.50	
Missing value	0	0.00	0	0.00	3	0.31	
Farm land size							
Less than 5 mu*	117	59.69	498	67.57	615	64.06	$\chi^2 = 1.428$
More than 5 mu	73	37.24	239	32.43	312	32.50	
Missing value	6	3.06	0	0.00	33	3.44	
Household size							
mean	4.679	-	4.723	-	4.718	-	T = -0.619
Number of Children							
Mean	1.633	-	1.881	-	1.830	-	T = 0.944
Total annual income							
Mean	25,6176.9	-	141,129.8	-	164,618.6	-	T = -3.875***
Annual household consumption and expenditure							
Mean	11.066	-	10.709	-	10.783	-	T = -2.693***

Note: *1 mu = 0.16 acre = 0.064 ha; *, **, *** Significant at the 10, 5, 1, percent levels, respectively; Source: The author's survey data, 2017.

4. Method and Empirical Results

Methods available for determining whether rural households are credit constrained include qualitative choice model approaches. If the random term built into them is assumed to have a logistic distribution, then one appropriate approach is a standard binary logit model. However, if it is assumed that the random term is normally distributed, then the model becomes the binary probit model [45,46]. In this study, we rely on the probit model because the loan decision conforms to the normal distribution assumption. The model is estimated by the maximum likelihood method. The baseline model for assessing the probability of both credit constraint and whether a household is borrowing from informal sources can be obtained by the following equation:

$$f(P_i) = \text{Prob}(Y_i = 1/X_{ij}) = \frac{e^{z_i}}{1 + e^{z_i}} \quad (1)$$

4.1. Credit Constraint Model (Model 1)

Choices about participation in financial markets are likely to be less frequent. Instances of these include buying a major appliance such as a farm implement or deciding whether (or how much) to borrow to purchase a major piece of equipment for their business. Inputs into these sorts of decisions can have a substantial qualitative component. As a result, qualitative choice models have been used in analysing participation in a variety of activities. Models for determining discrete choices such as whether to participate or not in state or local government programs, and to favour a particular political party are known as qualitative choice models. As credit constraint is an outcome of decisions people

make after considering their options and assessing their financial needs and circumstances, the process falls into the qualitative choice model.

This study uses a dichotomous choice framework to explain the likelihood that a household will be credit constrained. Credit constraint in the rural household is hypothesised to result from the following factors and can be implicitly written under the general form:

$$Y_{\text{creditconstrained}} = \alpha_0 + \sum \beta_j X_{ij} + \varepsilon_i \quad (2)$$

where, $Y_{\text{creditconstrained}}$ is a dummy variable, equal to “1” when a household is credit constrained and “0” otherwise:

α_0 and β_j are an intercept term and the coefficients of parameters, respectively. X_{ij} are the factors hypothesised to affect credit constraint for households, and ε_i is the error term.

The discrete dependent variable, credit constrained, is based on a question asked in the survey questionnaire: “Why doesn’t the family have any bank loans?”. The answers are either “applied for loans but was denied” or “needs loans, but has never applied”. The households’ characteristics such as gender, age, whether households are certified poor, farmland size, household total annual income, education level, household size and main source of income are hypothesised to influence whether households will be credit constrained. The choice of these independent variables is based on previous literature and Linh et al.’s [47] review on rural credit access in developing countries.

4.2. Informal Source Borrowing Model (Model 2)

Model (2) tests the specific attributes of households that do or do not borrow from informal sources. Similar to Model (1), this is a binary choice decision making situation. The parametric functional form for Model (2) can be written as follows:

$$Y_{\text{informalborrowing}} = \alpha_0 + \sum \beta_j X_{ij} + \varepsilon_i \quad (3)$$

where, $Y_{\text{informalborrowing}}$ is a dummy variable, equal to “1” if the household borrowed from informal sources, and “0” otherwise.

α_0 and β_j are an intercept term and the coefficients of parameters, respectively. X_{ij} are the factors hypothesised to affect the household’s decision whether to borrow from informal sources, and ε_i is the error term.

Equation (3) determines which household characteristics have significant influence on the household’s decision to borrow from informal sources. For example, Equation (3) allows examination of the question “aside from bank loans, did your family borrow any money from other sources for business activities?”

Table 5 presents the definitions of the variables used in Models (1) and (2).

The probit model determines the factors that affect credit access to both formal and informal credit institutions. It is recognised that rationing in the form of credit constraint has an impact on household outcomes, such as productivity and welfare [3,29,48]. Credit rationing has recently been estimated to have caused a 15.7 percent loss in net income and an 18.2 percent loss in consumption expenditures for rural households in China’s ten provinces [48]. Removal of credit constraints can improve rural household incomes by as much as 23.2 percent [15]. These figures are consistent with the studies by Li and Zhu’s [33], and Tran et al.’s [29] findings. Recognising that credit constraint is very likely to impact the welfare of rural households, we evaluated the contribution of demographic factors and borrowing from informal credit sources on household welfare. These were assessed using the endogenous switching regression model described next.

Table 5. Variables and definitions.

Variables	Description
Ln (annual household consumption expenditures)	Ln (total amount of households annual consumption expenditure for year 2015)
Constrained	1 = if household is credit constrained, 0 = unconstrained
Gender	1 = if household is male, 0 = female
Age (young age group)	1 = if household is younger than 35 years old, 0 = otherwise
Poor	1 = if household is certified as poor by the local authority in either year 2014 or 2015, 0 = has not been certified as poor
Household size	The number of people in the family
Farm land size	1 = household farm land size is less than 5 acres, 0 = household farm land size is more than 5 acres
Total annual income	The amount of households total annual income (includes farm income, non-farm income and subsidiary income)
Education level	1 = high school or higher, 0 = lower than high school
Occupation type	1 = households are doing agriculture related work, 0 = non-agricultural related work
Main source of income	1 = agricultural related income, 0=otherwise

4.3. Evaluation of the Impact of Credit Constraints on Rural Farm Households' Welfare

We use the endogenous switching regression (ESR) model to evaluate the impact of credit constraint on rural households' welfare. The model is useful for several reasons. First, we can only observe the welfare of either a constrained or non-constrained household. These two regimes exclude each other, and separate functions for constrained and non-constrained household welfare are necessary [49]. Second, credit constrained and non-constrained households may have different characteristics, such as credit demand and input factors that can affect the welfare differently [3,6]. Third, there might be a potential selection bias between credit constrained and non-constrained households. The credit constrained households may have lower welfare because they do not have enough resources for production. Whereas, non-constrained households do not face such restriction and thus, are able to choose optimal input production and create higher welfare [3]. The model has been used in previous studies to evaluate the impact that a variety of credit constraint-relevant factors have on rural households' welfare or productivity [3,29,50]. Here, we use the total annual consumption expenditure of the household as the welfare indicator.

Following Madala [46] and Baiyegunhi et al. [50], the welfare functions of credit constrained and unconstrained households can be expressed as:

$$\begin{aligned} Y_{1i} &= \delta_1 X_{1i} + \epsilon_{1i} \text{ if } CC_i = 1 \\ Y_{0i} &= \delta_0 X_{0i} + \epsilon_{0i} \text{ if } CC_i = 0 \end{aligned} \quad (4)$$

where Y_{1i} and Y_{0i} represent welfare function of credit constrained and unconstrained household i , respectively, δ_1 and δ_0 are vectors of parameters, ϵ_{1i} and ϵ_{0i} are error terms, and CC_i is the credit constraint condition of the household.

The credit constraint condition of the household is defined by:

$$CC_i = 1 \text{ if } CC_i = \alpha Z_i + u_i > 0, \text{ } CC_i = 0, \text{ otherwise.} \quad (5)$$

Z is a vector of household head and household characteristics, u_i is error term, α is the vector of parameters to be estimated.

Following Madala [46], u_i , ϵ_{1i} and ϵ_{0i} have a trivariate normal distribution with mean vector zero and covariance matrix:

$$\Omega = \begin{bmatrix} \sigma_u^2 & \sigma_{1u} & \sigma_{0u} \\ \sigma_{1u} & \sigma_1^2 & \cdot \\ \sigma_{0u} & \cdot & \sigma_0^2 \end{bmatrix} \quad (6)$$

where σ_u^2 is a variance of u_i , σ_1^2 and σ_0^2 are variances of ϵ_{1i} and ϵ_{0i} , respectively. σ_{1u} is a covariance of u_i and ϵ_{1i} , and σ_{0u} is a covariance of u_i and ϵ_{0i} . The covariance between ϵ_{1i} and ϵ_{0i} is not defined, as Y_{1i} and Y_{0i} cannot be observed simultaneously. σ_u^2 can be assumed to equal 1, as α can only be estimated up to a scalar factor [33].

The system of Equations (4) and (5) are estimated simultaneously using full information maximum likelihood method [51]. Given the assumption on the distribution of the error terms, the logarithmic likelihood function of the model is:

$$\ln L = \sum_i (I_i w_i [\ln\{F(\eta_{1i})\} + \ln\{f(\epsilon_{1i}/\sigma_1)/\sigma_1\}] + (1 - I_i) w_i [\ln\{1 - F(\eta_{0i})\} + \ln\{f(\epsilon_{0i}/\sigma_0)/\sigma_0\}]) \quad (7)$$

where F is a cumulative normal distribution function, f is a normal density distribution function, w_i is an optional weight for household i , and:

$$\eta_{ji} = \frac{(\alpha Z_i + \rho_j \epsilon_{ji}/\sigma_j)}{\sqrt{1 - \rho_j^2}} \quad j = 0, 1 \quad (8)$$

where $\rho_1 = \sigma_{1u}^2 / \sigma_u \sigma_1$ is the correlation coefficient between ϵ_{1i} and u_i , and $\rho_0 = \sigma_{0u}^2 / \sigma_u \sigma_0$ is the correlation coefficient between ϵ_{0i} and u_i .

5. Empirical Results

The probit models' results on credit constraint are presented in Tables 6 and 7. The models fit the data quite well, as the chi-square test results strongly reject the hypothesis of no explanatory power for both equations ($\chi^2 = 15.73$, $p = 0.0153$ for the credit constraint model; $\chi^2 = 34.74$, $p = 0.000$ for the informal source borrowing model). The percentage of observations that are correctly predicted by the credit constraint model is 72.24 percent, with 63.70 percent successful predictions for the informal sources borrowing model. The average VIFs are 1.09 for the credit constraint model and 1.08 for the informal sources borrowing model, which confirms that both models do not suffer from a multicollinearity problem.

Table 6. Credit constraint model results.

Variable	Coefficients	t-Statistic	Marginal Effects	Ranking
Gender	0.0881	0.40	0.02951	
Age	0.3822 *	1.82 *	0.1176	2
Poor	−0.9268 ***	2.72 ***	−0.3496	1
Household size	−0.0955 **	1.96 **	−0.0315	4
Farm land size	0.3307 *	1.74 *	0.1108	3
Main source of income	0.1488	0.76	0.0483	

Note: Number of observations = 263; LR Chi2(6) = 15.73; Prob > chi2 = 0.0153; R2 = 0.0506; PCP (percent correctly predicted) = 72.24%; Vif = 1.09; *, **, *** significant at the 10, 5 and 1 percent levels, respectively.

Table 7. Informal source borrowing model results (no bank loan and borrowing from informal sources).

Variable	Coefficients	t-Ratio	Marginal Effects	Ranking
Gender	0.0324	0.21	0.0124	
Age	0.1448	2.35 **	0.0552	3
Farm land size	0.3432	2.51 **	0.1321	2
Educational level	−0.4260	−3.12 ***	−0.1637	1
Poor	−0.2531	−0.96	−0.0989	
Distance to bank	0.0212	1.26	0.0081	

Note: Number of observations = 427; LR Chi2(6) = 34.74; Prob > chi2 = 0.0000; R2 = 0.0609; PCP (expected percent correctly predicted) = 63.70%; Vif = 1.08; *, **, *** significant at the 10, 5 and 1 percent levels, respectively.

5.1. Determinants of Credit Constraints

Table 6 presents the estimation results of Model (1). There are positive, significant effects of farm land size and young age households on the household's likelihood of being credit constrained. The conditions of households that are certified poor by the local authority, and household size negatively effects the households' credit constrained position. These results imply that the certified poor and households with large household sizes are less likely to be credit constrained from formal credit sources. The significantly negative effect of household size on the households' credit constraint indicates that households with larger family sizes have an advantage when approaching formal credit sources. The greater the number of adult dependents in the household, the less likely it is to be credit constrained. More adults in a household will generally contribute to a greater proportion of the labor necessary to increase farm production and repayment capability [3].

The certified poor by the local authority is considered the target group for subsidised credit in China. Lending policies (e.g., subsidised interest rates) of both the central government and local governments alike are in place that were designed to enhance the credit access of the rural poor [17]. For example, in 2015 the Fujian province government provided 50 million RMB of subsidised interest funds to certified poor rural households who borrowed. Consequently, 20,000 poor rural households received loans with subsidised interest [42]. Thus, certified poor households are less likely to be credit constrained due to these credit subsidisation policies.

The effect of farmland size is positive and significant on formal credit constraint. It is important to emphasise that farmland size is an indicator for production capacity rather than being treated as collateral, as farmland is state owned and consequently, there is no market for the sale of agricultural land in China. The effect of farmland area is that households possessing larger farmland size are more likely to be credit constrained. This finding supports the findings of Jia et al. [17], where farmers with larger lands are inclined not to apply for credit because they are more likely to be rationed by formal credit institutions.

The significantly positive effect of young age on the households' credit constraint indicates that heads of households that are less than 35 years old have higher propensity of being credit constrained. This may be due to the fact that younger farmers are seen to have substantially lower levels of experience and cannot provide valuable off-farm work skills. These factors are more likely to lead

lenders to assume that they have bad loan repayment abilities [14]. Young aged rural households are also expected to have smaller social networks than middle or older age borrowers. A larger social network can improve the ability of borrowers to repay loans and can also reduce transaction costs for lenders related to screening, monitoring and enforcing credit contacts. Thus, young aged household heads have limited social networks, poor access to credit sources and less rural production experiences, thus, a higher possibility of credit constraint [52,53].

Additional information can be obtained through an analysis of the marginal effects calculated as the partial derivatives of the non-linear probability function, evaluated at each variable's sample mean [48]. Marginal effects analysis reveals that among the factors affecting credit constraint from formal sources, being certified poor by the local authority has the strongest marginal effect on the probability of credit constraint from the formal credit sources. This effect was followed by age, farmland size and household size.

5.2. Determinants of Informal Borrowing

Table 7 documents that borrowing from informal credit sources is influenced by age, households' level of education and whether households are constrained from formal credit institutions. Our Model (2) results show that the older farmer who has less education and is credit rationed from formal sources is more likely to borrow from informal credit sources. These results confirmed the substitutive relationship between formal and informal lending and suggest informal credit fills a gap in credit supply and demand in the formal sector. The significant positive effect of age on the household's choice of informal loans can be explained by noting that aging households are likely to have better structured social networks. Most informal borrowing relies on relatives and friends or other members of social networks [49], with older people having a larger number of contacts in their networks. This result is supported by the findings of Li et al., [48], Jia et al. [54], and Yuan and Xu [14]. In these, rural households' social networks of relatives, friends and other individuals they know, were the primary sources relied upon to meet farmers' demand for credit.

The formal credit constrained variable has a positive sign, and significantly affects the household's access to informal credit. Households apply for loans from informal sources because they either fear rejection by the bank considering their request or their loan applications have been rejected by formal credit sources [6]. This finding is consistent with the studies of Turvey et al. [32], Yuan and Xu [14,55], higher rates of informal borrowing is a consequence of credit rationing from formal credit sources. As a consequence, informal credit is likely to be more active in the regions where the formal credit market is less developed, such as in rural areas [14,32].

The effect of education on informal credit demand is negative and significant. Rural households with more education generally earn higher incomes, which reduces credit demand [48] and increases access to formal credit [32]. Households with more years of education are believed to allocate credit more efficiently and are expected to have improved access to formal credit sources [17,34,56].

Similar to Model (1), our marginal effects analysis shows that among the demographic variables affecting respondents' borrowing from informal sources, formal credit constraint has the strongest marginal effect (see Table 5). Formal credit constraint dominates rural farmers' access to and reliance upon informal credit. In the case where a rural household can borrow from formal credit institutions, formal credit constraint nevertheless increases his/her probability of borrowing from informal credit sources. Education level is ranked as the second most important factor that impacts households' borrowing from informal sources. This is followed by the age variable.

5.3. Impact of Credit Constraint on Rural Household Welfare

Table 8 shows the results obtained from the second step of the endogenous switching regression model (Equations (4) and (5)). The likelihood ratio (LR) test is significant at the five percent ($p = 0.046$) level, which indicates that the endogenous switching model is better than the exogenous model at predicting credit constraint. Furthermore, the significance of ρ_1 implies that the sample may suffer

from selection bias and that OLS (Ordinary Least Square) estimation would result in biased estimates. Since ρ_1 is negative and significant at the one percent level, we can conclude that credit constrained households have lower consumption per capita than a credit unconstrained household. The negative and insignificant sign of ρ_0 documents that there is no difference of consumption per capita between a credit constrained household and credit unconstrained household. The result supports Li and Zhu's [33] and Tran et al.'s [29] studies which revealed that credit constraints have a detrimental impact on household consumption.

Table 8. Impact of credit constraints on household's consumption per capita.

Variable Name	Endogenous Switching Model		OLS	
	Credit Unconstrained	Credit Constrained	Credit Unconstrained	Credit Constrained
Age	−0.0177 (0.843)	0.0747 (0.320)	−0.0228 (0.830)	0.0507 (0.508)
Farm land size	−0.4151 (0.020) **	−0.0862 (0.558)	−0.3309 (0.091) *	−0.1106 (0.465)
Household size	0.1079 (0.009) ***	0.1182 (0.006) ***	0.1224 (0.018) **	0.1187 (0.010) **
Educational level	0.0239 (0.894)	0.2480 (0.094) *	−0.0551 (0.780)	0.2061 (0.181)
Occupation type	−0.2237 (0.184)	−3.113 (0.041) **	−0.3113 (0.117)	−2.8763 (0.072) *
Borrowing from informal	No	−0.0413 (0.783)		−0.0825 (0.597)
Constant	10.2216 (0.000) ***	10.7412 (0.000) ***	10.6299 (0.000) ***	10.4351 (0.000) ***

ρ_0 −0.7011(0.646); ρ_1 −1.1067(0.001) ***; Log likelihood −417.317; Wald test 11.87 **; LR test 6.14(0.046) **

Notes: OLS stands for Ordinary Least Square. Figures in parenthesis are *p*-values; ρ_0 and ρ_1 are the correlation between the error terms of the credit constraint condition equation and equations of consumption per capita of credit unconstrained respondents and constrained respondents, respectively. *, **, ***, significant at 10, 5 and 1 percent level, respectively.

The variable “borrowing from informal” appears only in the consumption Equation (4) for credit constrained households. The insignificant effect of this variable on consumption per capita implies that informal lending did not help rural farmers in Fujian province to improve their level of consumption and welfare. Table 6 also shows the difference in the significance of farmland size, educational level and occupation type variables between the consumption equations of credit constrained and unconstrained households. The insignificance of farmland size in the consumption equation of credit constrained households implies that for credit constrained families, the role of larger farmland size in improving household welfare is negligible. The insignificance of educational level and occupation type in the consumption equation of credit unconstrained households and the significance of these two variables in the credit constrained household's consumption models indicate that for the in credit constraint condition, the rural household with a higher level of education increases their consumption expenditure significantly, and sufficient credit can help households who are doing agricultural-related work to equal their consumption with households who rely on non-agriculturally related work. The results are supported by Dong et al.'s [3] findings which reveal that without adequate credit for rural production and recourses, households with capabilities and education cannot be fully utilised or employed.

Table 8 also shows that an additional member in credit constrained households increases consumption per capita by 11.82 percent while in the credit unconstrained households it is only 10.79 percent. This reflects the fact that kids or elders generally increase household consumption, and the expenditure for an extra household member is higher in the credit constrained condition. The result

supports Rosati et al. [57] and Dong et al.'s [3] findings that when a household is credit constrained, the limited amount of savings might be used as an emergency fund rather than being used in rural production (e.g., emergency fund for family members' illnesses).

6. Conclusions and Policy Implications

Credit markets in China play an important role in promoting rural development. However, poor rural households are often excluded from formal credit markets [16]. Previous studies have found farmers who are constrained by formal credit may resort to informal credit markets and thus alleviate their financial constraints [14,16,52]. This study provides direct evidence of how rural households' demographic factors influence their access to both formal and informal credit. In addition, this study also investigates whether credit constraint affects rural households' consumption.

Our empirical testing of the 2017 survey data from Fujian province confirms that formal credit constraints are affected by age, farmland size, household size and total annual income. Poor rural households are now less likely to be excluded by formal credit sources as the government's subsidised credit policy effectively supports poor rural households' credit demand. Our results also show the decision to borrow from informal credit sources can be positively affected by formal credit constraint. Age and households' educational level negatively affect the rural households' decision to borrow from informal sources. Moreover, testing with the endogenous switching model shows that credit constraints have a negative impact on household welfare in the study region.

The results from this study provide potentially important policy implications. First, our results have shown that certified poor rural households are less credit constrained. Thus, the government subsidised credit policy has been found to be efficient in improving the household's accessibility to formal credit. Our study results confirm that relaxing the credit constraints can not only enhance the welfare of poor rural households but also narrow the welfare gap between the poor and non-poor rural households. Second, the government should consider designing policies to relax credit constraints for rural households. Our ESR model result recommends that under the credit constrained condition, the rural households with higher levels of education have a greater consumption burden. Rural households with higher education guarantee that credit is used efficiently in rural production. However, additional education cannot be fully utilised in agricultural production, only when credit constraint is removed. In other words, for additional education to improve rural productivity, the credit constraint needs to be removed first [3]. Third, our results confirm that the informal lenders can overcome the weakness of formal credit with low transaction costs and more efficient and potentially more effective credit allocation. This expands rural households' ability to raise funds that will be used to enhance farmland production. Therefore, it would seem prudent for policy makers to take steps to incorporate informal credit into the credit marketplace in Fujian province.

Fourth, the impact of subsidised credit on Chinese rural household welfare has been documented in a number of studies [58–60], however, how subsidised credit is allocated raises an important question. Is "subsidised credit" sustainable in the longer term? Subsidised credit designed to support needy households could potentially benefit only better-off groups as criticised by Braverman and Guasch [61], and Gonzalez-Vega [62]. In addition, subsidised credit may lead to the increase in interest rate charged by informal lenders because some money lenders will exit the market since the pool of borrowers left are riskier than the conventional pool. As a result, credit constrained households may suffer from adverse effects of subsidised credit since they are forced to borrow from informal lenders. Thus, subsidised credit may exacerbate welfare and rural development inequality. Our results suggest that it is necessary to enhance the credit allocation system to reduce the transaction cost and provide target households with sufficient credit to enhance rural development. Policy makers and formal credit institutions should develop a relevant credit policy, improve financial and physical infrastructure to assure rural communities can receive sufficient loans for production and consumption.

Fifth, the government should not address the credit constraint issue exclusively by providing credit to the households. Investing in other programs, such the households' education and developing

non-farm activities in rural areas are other solutions to alleviate the credit constraint issue. Results from our study suggest that educated households are less likely to be dependent on credit and more favoured by creditors. In addition, education is also a key factor to promote rural household welfare [63,64]. Similarly, non-farm activities contribute to relax credit constraints and improve rural household welfare. Ellis [65] and De Brauw and Harigaya [66] reveal that farm households with diversified income sources are better able to encounter adverse incidents, thus, are less reliant on credit and have higher consumption expenditure.

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